

Listing of the Claims:

The following is a complete listing of all the claims in the application, with an indication of the status of each:

1 Claim 1 (Currently Amended). A computer implemented encoding and
2 correcting method comprising the steps step of:
3 transforming encoding and decoding matrices of GF (2ⁿ), the
4 Galois Field of 2ⁿ elements for n greater than one, and wherein the
5 converted code is a (3,3) code of distance four; and
6 encoding data and correcting erasure errors using performing-only
7 exclusive OR operations on complete data words for error correcting codes
8 with four or more check symbols which can correct as many errors as there
9 are check symbols.

Claim 2 (Canceled).

1 Claim 3 (Previously presented). A computer implemented method for
2 encoding data and correcting erasure errors comprising the steps of:
3 converting a code over a finite field of characteristic two which can
4 correct up to e erasure errors into a code which can correct up to e erasure
5 errors in words;
6 encoding data using the converted code;
7 reading the encoded data and correcting up to e erasure errors in
8 words, wherein the converted code is a (3, 3) code, wherein even if all the
9 information in any three of the words w_i is erased, the data can be
10 recovered.

1 Claim 4. (Previously presented) A computer implemented encoding and
2 correcting method comprising the steps of:
3 transforming encoding and decoding matrices of GF(2ⁿ), the Galois
4 Field of 2ⁿ elements for n greater than one, and
5 encoding data and correcting erasure errors using only exclusive

6 OR operations on complete data words.

1 Claim 5. (Original) The computer implemented encoding and correcting
2 method recited in claim 4, wherein a (3, 3) code of distance four is used.

1 Claim 6. (Previously presented) A computer implemented method for
2 encoding and correcting four or more erasure errors in data whose
3 locations are known, comprising the steps of:
4 converting a code over a finite field of characteristic two into a
5 code whose encoding and correcting algorithms involve only exclusive OR
6 (XOR) operations of complete data words;
7 reading data from main volatile memory and encoding the data
8 using only XOR operations to generate a correcting code;
9 storing data and correcting code in an auxiliary array of non-
10 volatile storage devices;
11 reading the data from the auxiliary array of non-volatile storage
12 devices; and
13 reconstructing erasure errors in the data read from the auxiliary
14 array of non-volatile storage devices using only XOR operations to
15 generate reconstructed data.

1 Claim 7. (Original) The computer implemented method recited in claim 6,
2 wherein the code whose encoding and correcting algorithms involve only
3 XOR operations of words is a (3, 3) code of distance four.

1 Claim 8. (Original) The computer implemented method recited in claim 7,
2 wherein the code whose encoding and correcting algorithms involve only
3 XOR operations of words is based on a code of six symbols, $x_0, x_1, x_2, x_3,$
4 $x_4,$ and x_5 , each of which is an element of GF(4), the Galois Field of four
5 elements, and where x_0, x_1 and x_2 are information symbols and x_3, x_4 and x_5
6 are check symbols, the check symbols being defined by:

$$\begin{bmatrix} x_3 \\ x_4 \\ x_5 \end{bmatrix} = \begin{bmatrix} 1 & 1 & 1 \\ 1 & a & a^2 \\ 1 & a^2 & a \end{bmatrix} \begin{bmatrix} x_0 \\ x_1 \\ x_2 \end{bmatrix}, \text{ that is } \underline{X}_C = A\underline{X}_1,$$

where a is an element of $\text{GF}(4)$ which satisfies the equation $1+a+a^2=0$.

Claim 9. (Original) The computer implemented method recited in claim 8, wherein by substitution $\underline{X}_C = A\underline{X}_1$ becomes $\underline{W}_C = r(A)\underline{W}_1$, where \underline{W}_C is a correction word and \underline{W}_1 is a data word to be reconstructed.

Claim 10. (Original) The computer implemented method recited in claim 9, wherein, given a linear code over $\text{GF}(2^n)$, the Galois Field of 2^n elements, which can correct up to e erasure errors, to a code which can correct up to e erasures in words, and whose encoding and correcting can be performed by XORing words, the method comprises the steps of:

encoding the linear code in the form $\underline{X}_C = A\underline{X}_1$, and each of the corrections is also of the form $x_i = B_i X$, where A and the B_i s are matrices over $\text{GF}(2^n)$;

choosing a representation, r , of $\text{GF}(2^n)$, which representation assigns an $n \times n$ matrix, $r(a)$, for every element a in $\text{GF}(2^n)$, whose elements are in $\text{GF}(2)$, i.e., are "0" or "1";

obtaining the decoder of converted code by substituting the matrix $r(a)$ for every element a of A , to obtain the matrix A , and substituting w_i for x_i in \underline{X}_1 and in \underline{X}_C , where $w_i = (w_{i,0}, w_{i,1}, \dots, w_{i,n-1})^t$ to obtain \underline{W}_1 and \underline{W}_C , the encoder of the code being $\underline{W}_C = r(A)\underline{W}_1$; and

substituting $r(a)$ for every element a of B_i to obtain $r(B_i)$ and substituting w_j for every element x_j of \underline{X} to obtain \underline{W} to recover x_i by using $w_i = r(B_i)\underline{W}$.

1 Claim 11. (Previously presented) A computer system for correcting four or
2 more erasure errors whose locations are known, comprising:
3 a main volatile memory and an auxiliary array of non-volatile
4 storage devices connected for transferring data therebetween;
5 an encoding means for converting a code over a finite field of
6 characteristic two into a code whose encoding and correcting algorithms
7 involve only exclusive OR (XOR) operations of complete data words, data
8 read from said main volatile memory being encoded by said encoding
9 means using only XOR operations to generate a correcting code and stored
10 with the correcting code in said auxiliary array of non-volatile storage
11 devices; and
12 data reconstructing means which, when data is read from the
13 auxiliary array of non-volatile storage devices, reconstructs erasure errors
14 in the data read from the auxiliary array of non-volatile storage devices
15 using only XOR operations to generate reconstructed data.

1 Claim 12. (Original)The computer system recited in claim 11, wherein the
2 code whose encoding and correcting algorithms involve only XOR
3 operations of words is a (3, 3) code of distance four.

1 Claim 13. (New) A computer implemented encoding and decoding
2 method, comprising the steps of:
3 encoding data transferred from a memory to a storage device using
4 only XOR operations on complete data words; and
5 reconstructing data stored in said storage device using only XOR
6 operations on complete data words.